# Quasiparticle dynamics and electron-phonon coupling in graphene

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Graphene and graphite are important mother systems for carbon-based materials such as carbon nanotube and fullerene. Insight into these materials to understand the role of electron-phonon (e-ph) interaction has been attracting considerable research interests. Recently, experiments of high resolution angle-resolved photoemission spectroscopy (ARPES) are performed on graphite, and a sharp quasiparticle (QP) peak is observed at the Fermi surface ($E_F$). However, up to now, it is still puzzling and controversial that whether this sharp QP peak is due to a strong e-ph interaction or not [1,2].

In order to reveal the nature of this QP peak, we theoretically study the ARPES of a monolayer graphene by using quantum Monte Carlo simulation method. Our calculation confirms that a well-defined sharp QP peak arises at $E_F$, as shown in Fig. 1(c). But intensity of this peak decreases dramatically with the increase of e-ph coupling strength *S*. Furthermore, an energy gap may open at $E_F$ provided large coupling *S*, justifying that the e-ph interaction in graphene cannot be very strong. In connection with ARPES, we have also intensively investigated the relation between QP dynamics and e-ph interaction, electronic states and doping level in graphene.

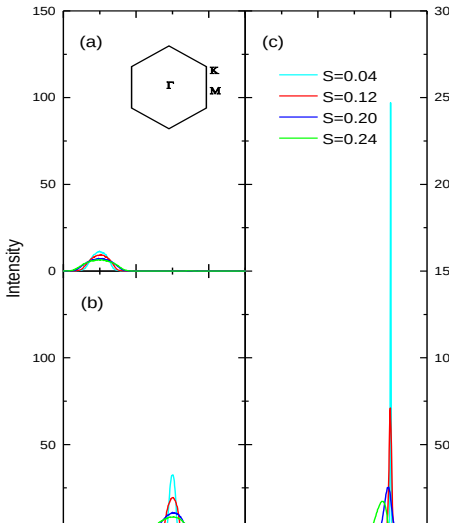


Fig. 1. Calculated ARPES intensity for graphene at (a) Γ, (b) M, and (c) K points under given e-ph coupling constants *S*. Inset of (a) shows Brillouin zone.

[1] K. Sugawara, T. Sato, S. Souma, T. Takahashi, and H. Suematsu, Phys. Rev. Lett. **98** (2007) 036801.
[2] C. S. Leem, B. J. Kim, Chul Kim, S. R. Park, T. Ohta, A. Bostwick, E. Rotenberg, H.-D. Kim, M. K. Kim, H. J. Choi, and C. Kim, Phys. Rev. Lett. **100** (2008) 016802.